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ARCHITECTURE AT RICE

GENERAL EDITOR

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HOUSTON, TEXAS

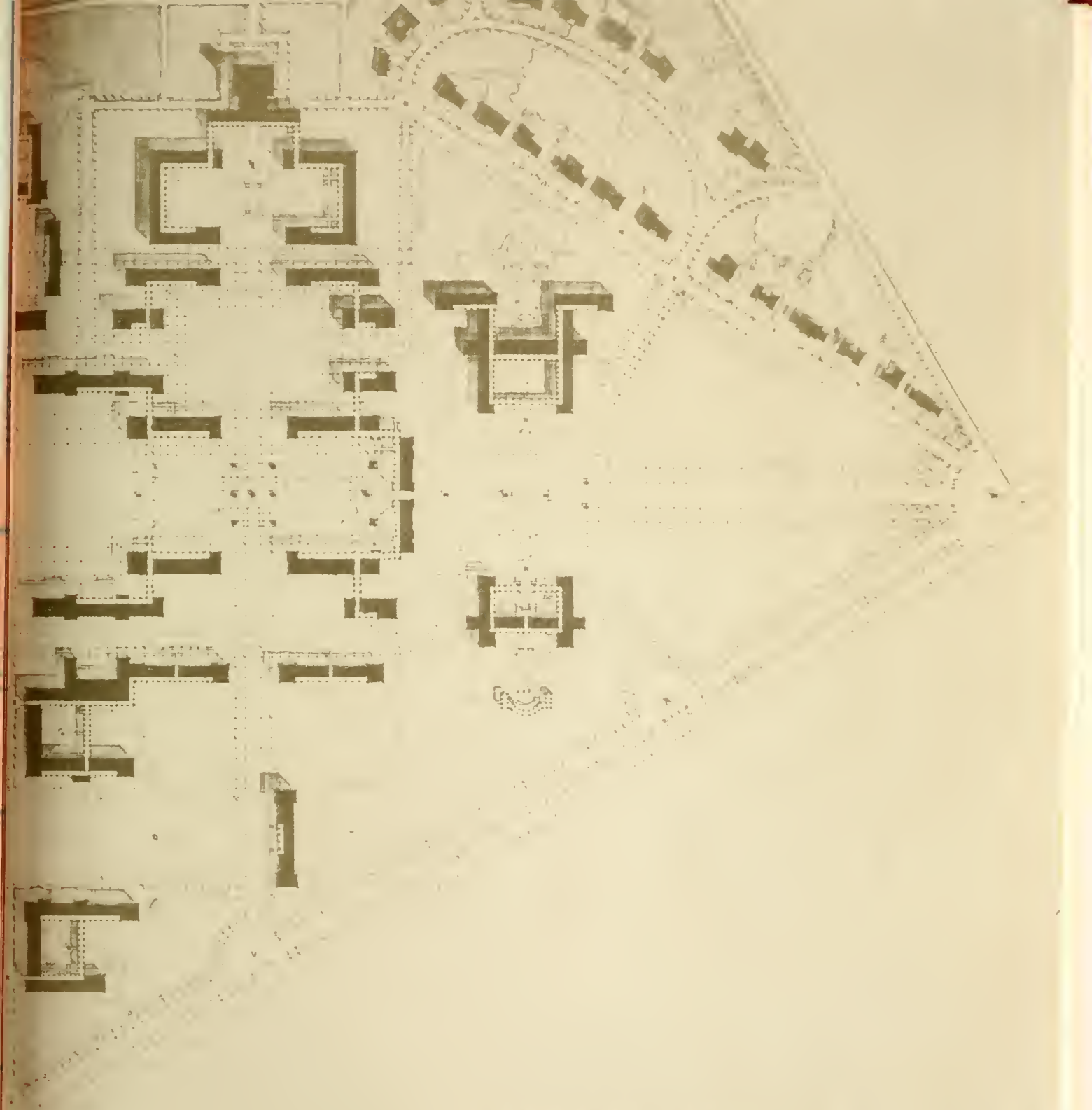
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ARCHITECTURE AT RICE



GENERAL PLAN
WILLIAM M. RICE INSTITUTE
HOUSTON TEXAS

SCALE 1/8" = 1' - - - -

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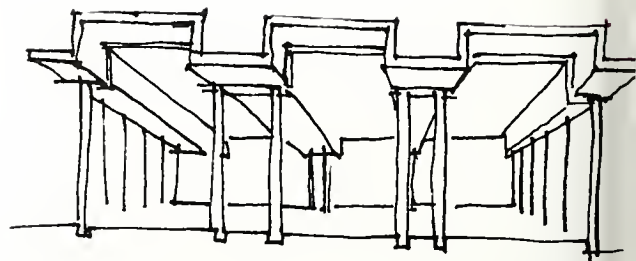
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AT RICE UNIVERSITY

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LAYMEN SHARE IN WHAT THEY ARE
THINKING AND DOING.

HOUSTON, TEXAS

JANUARY, 1964



THE AESTHETICS OF FOLDED PLATES

CLOVIS B. HEIMSATH, AIA
Assistant Professor of Architecture, Rice University

an address on architectural aspects of folded plate construction
given for the Structural Conferences on Folded Plates held at
Tulsa State College of Technology, April 1963
The University of Houston, April 1963
Southern Methodist University, September 1963

Not many years ago architects went to great efforts to cover up the clear structural forms brought into building by the engineer. Each new form, the steel truss, the shell, the hyperbolic paraboloids, the folded plates threatened aesthetics as interpreted by the architect. Architects are often called "form givers," yet once they were the "form removers." Today the bars are down. In the all-encompassing name of Contemporary Architecture anything seems to go. It is interesting that in the short span of fifty years architects and engineers have turned from fearing to espousing each new structural form. The credo of some seems to be the bolder the better, the more the better, and it seems the less studied the bolder.

Structural exhibitionism is loose in the world and nothing short of good common sense will end the conglomeration of misuse. A recently opened shopping center in Houston is literally packed with forms, each a mere echo of the grand structure it would like to be, each fighting and upstaging the next. If the poor observer is confused by the visual world around him, there is good reason. The fact is the visual world around him is confused. Too often the building profession itself is to blame, for not everything goes, even in the name of progress. The aesthetics of architecture is changing, but this is different from not having an aesthetics. Design principles are as vital to good architecture today as in the past; and although more flexible today, they operate to guide the hand of the serious designer.

Gestalt psychology, a school which expounds that the response to an environmental situation is complete and unanalyzable rather than a sum of specific and individual reactions to particular elements, has through experimentation established many telling insights into the brain as it experiences form. Humans lack the feelers of the bug which warn the bug of danger, yet man is handsomely compensated with a mind which intuitively judges the visual world around him and plots his action. For the Gestalt psychologist, aesthetic judgment is closely linked with survival. From primordial time man has learned to judge distance, movement, form and space as if his life depended on this intuition alone. Even in our civilized life today, it often does. Few of us cross a busy street without looking both ways, or walk into a dark tunnel, or climb out on a scaffolding after the workmen have gone home. Recently a house in Houston was demolished and the supports were removed from a side porch. For days the porch roof hung out in space, cantilevered off the second floor. No one would walk beneath.



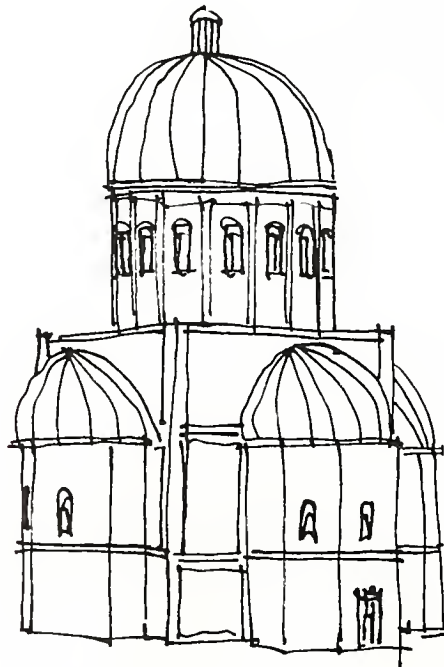
While experience showed the roof would stay up, intuitively the viewer knew that it was not supposed to. In short, it was strange! The viewer was disquieted. The neighbors slept better when it was finally torn down.

Man sees far more than he generally admits. When something is understandable, his mind rests. When something is not clear, he reacts with confusion. Although few visual situations actually forebode danger, man can not have a correct evaluation of this unless his mind is constantly looking, judging, intuitively calculating.

How can Gestalt help in an evaluation of folded plate structures? Perhaps with a greater awareness of the mind's probing ability to evaluate, the source of good and confused design can be appreciated more fully. For example, a folded plate is a long span structure. The professional's knowledge of structure makes this clear; the non-professional's eye intuitively tells the same thing. When a folded plate is used on what is quite clearly a short span situation, it may irritate the professional, but without any question it confuses the spectator. Intuitively he evaluates the deep section of the fold and "feels" that it can span a goodly distance. If it does not, he has been fooled; his intuitive judgment miscalculated. Surely he is not expected to react with glee over

this affront to his common sense. A meaningless form is that and nothing more. It is a meaningless form. When a folded plate has meaning, it is clear, it does its job simply, and it does no job for which it is not suited. It is designed to respect the composition of which it is a part, its neighbors to each side, and the uninterrupted space which it implies.

Certain situations ripe for ugliness and misuse are common to most applications of the folded plate. First of all, the folded plate, as other exposed structural forms, is an entity in itself. It merges with other forms only at great peril. The problem is not unlike that of a dome with which architecture has had far greater experience. A dome is a structural entity. Throughout history it has been expressed as one undefilable unit of composition. It has been pristinely set above the square crossing of the nave with transitional squinches, later by the custom-designed pendentives, and it took the Renaissance 200 years to perfect this one transition from one form to another.



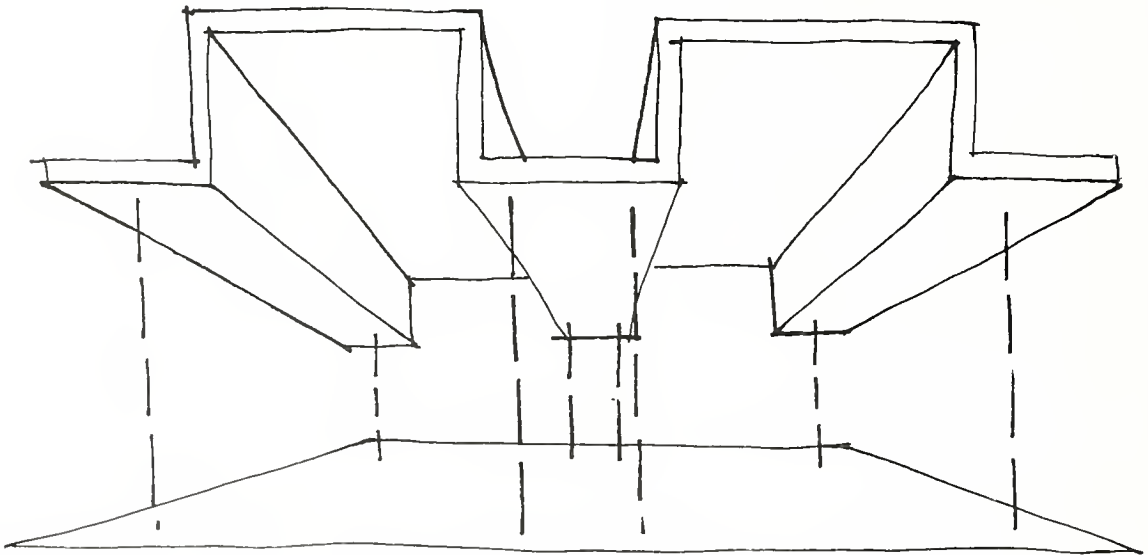
The dome, when squashed together as in the trulli houses, loses its clarity. And while the houses are picturesque, they are unfortunate transitions between domes.



The contemporary designer seems even less sensitive to the aesthetics involved with folded plates, and he thinks nothing of interrupting them, pasting trivial secondary forms to the sides, perhaps setting a long, one-story office wing hard beside a three-story machine shop.



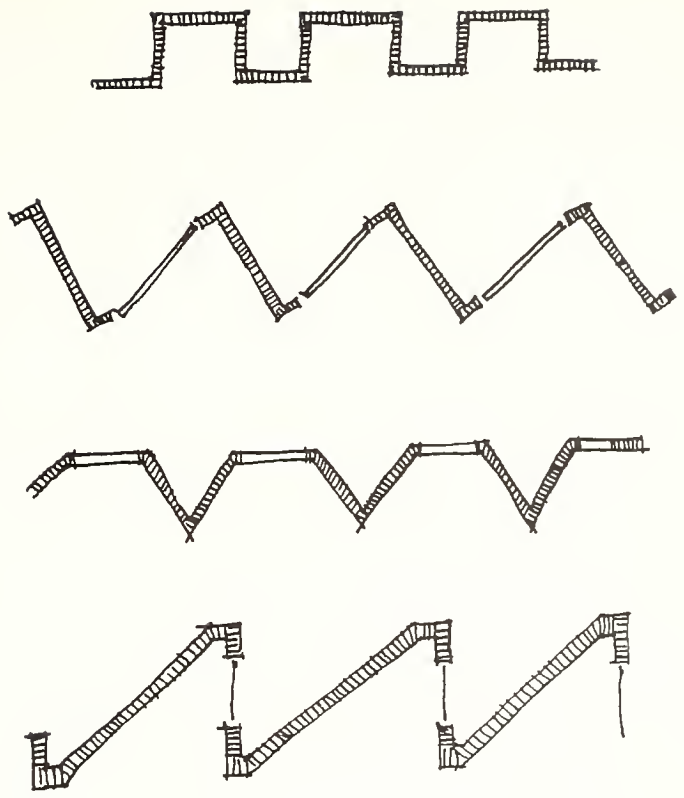
The entity of the folded plate is by nature repetitive. Seldom is there one folded plate; rather they are built in sequence. The modulation of the roof sets up a pattern which strongly effects the facade beneath, as the columns did on the Greek temple or in a medieval arcade. No one would think of bricking up every eighth space between columns on a Greek temple, yet similar design lapses occur far too frequently with folded plates and similar exposed structural forms. Repetitive forms such as the folded plate must create a compositional framework for other elements, and the cap must fit the head. The parts must be in proportion.



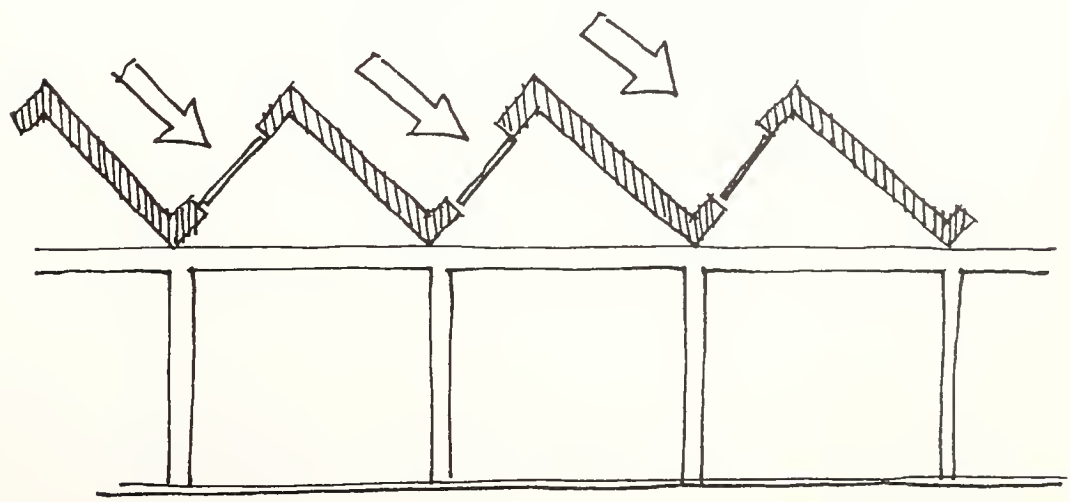
Aesthetics has changed, yet good proportion is an much a part of contemporary composition as it was historically.

When speaking of composition and proportion, the factors to be considered in the design are the other elements of the composition. These elements can help determine the type plate to use, answer some of the variables and lead to a balanced composition.

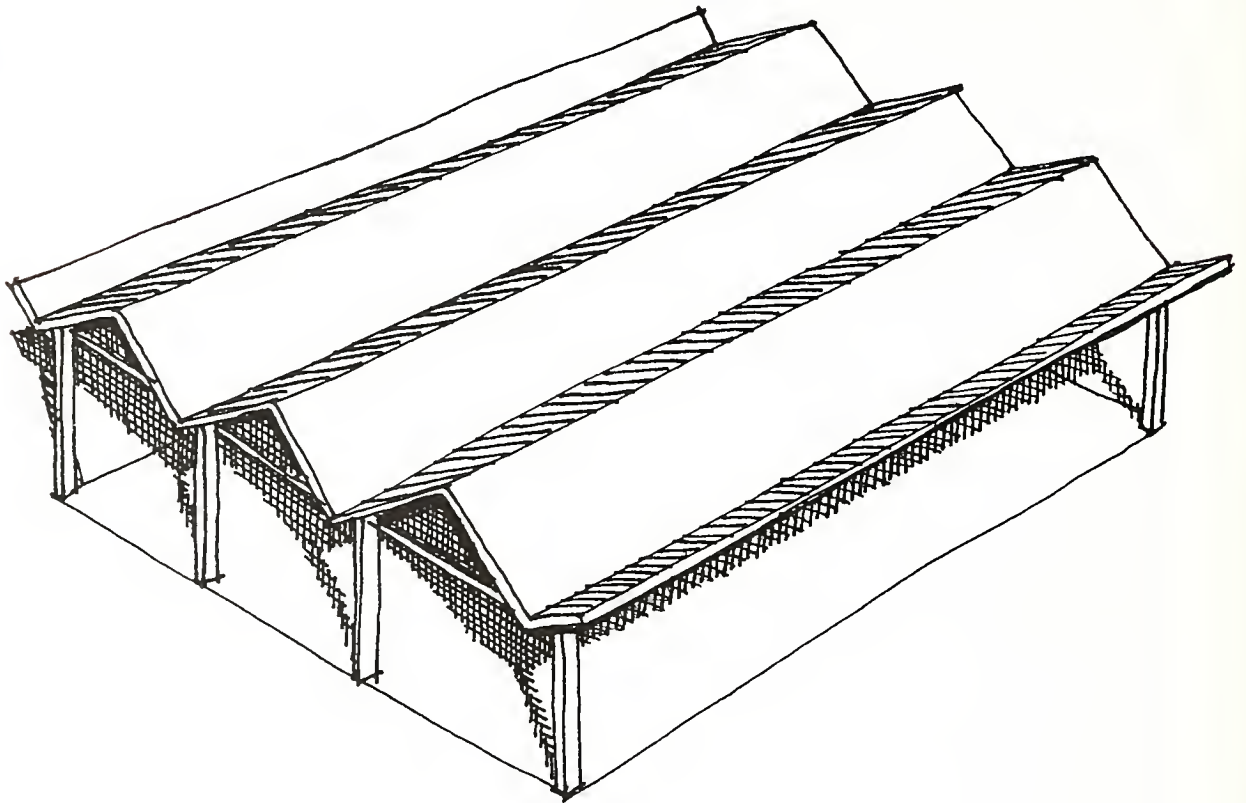
For any given span and loading condition, there may theoretically be an optimum structural form. It is stated rule of thumb that the most economical depth is $1/15$ th of the span. Yet there are variables in the design of folded plates, and there are any number of optimum designs, depending upon which variables are chosen. The angle of fold, the height and the thickness can vary, and the forms themselves can be Z's or V's or prismatic forms of many varieties.



One of the most interesting shapes is the Z-form which combines structure and excellent overhead lighting.



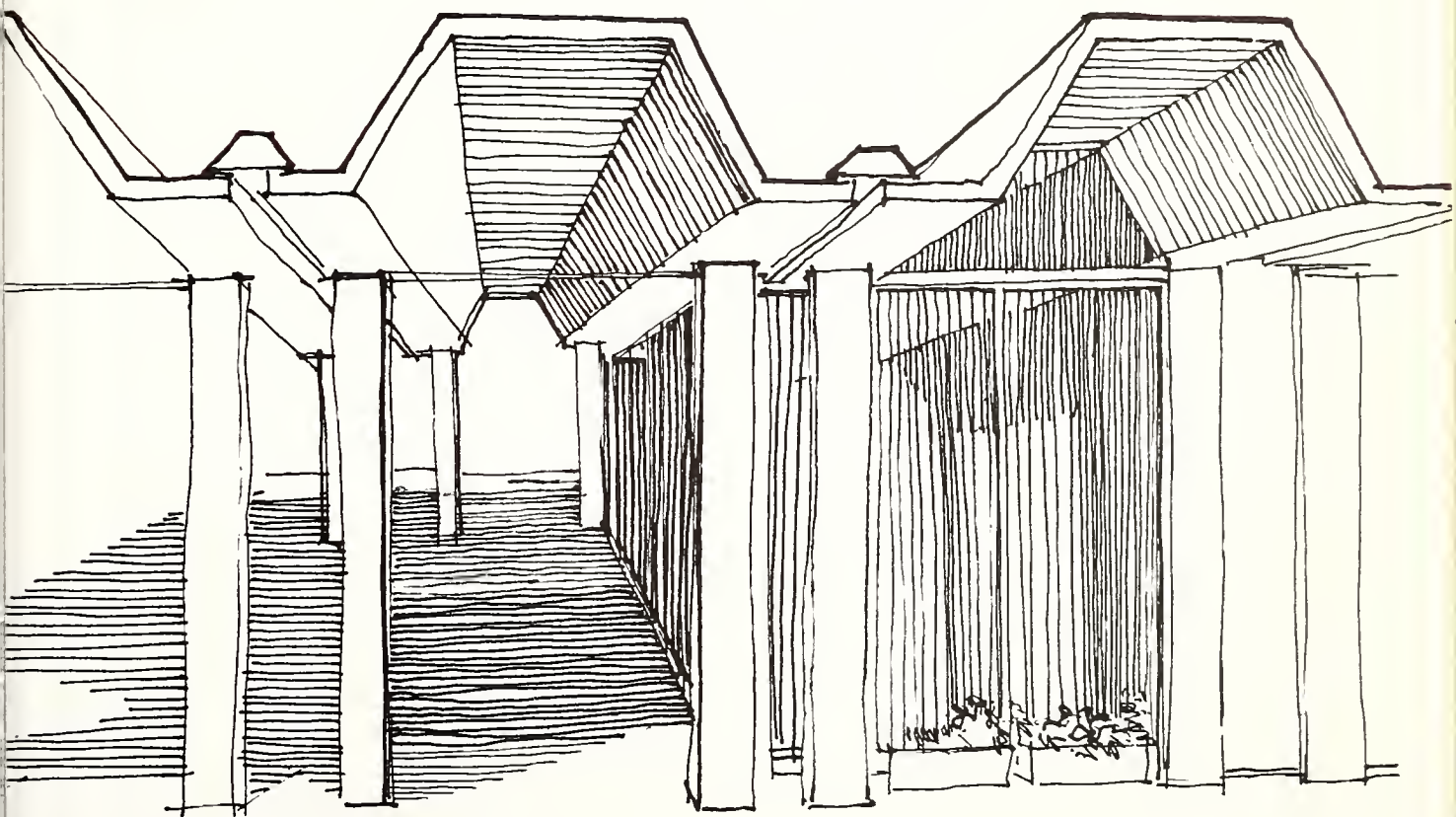
Support for the plate roof can be effective or disastrous. In buildings in which it is effective, it is honest and clear. The roof itself should "read," so the structure supporting it should be made known. Folded plates which span rectilinear spaces clearly create two types of facades, the front and back facades which are articulated by the folds, and the side facades which usually look like weak sisters.



Architecturally there is a dilemma here — why should any structure which looks so good from the front look so dull from the side? Too often the designer feels obligated to "dress up" the blank wall at the ends, introducing trivia because he can't or won't accept the simplicity of what he finds. The side walls should not read as bearing walls if the plate is to keep its integrity. An edge beam is often needed to beef-up the point where continuity is interrupted, but this should be expressed as separate from the infill wall below. If the end wall runs up flush under the edge beam, the eye will read the wall as loadbearing and the clarity will have been weakened. A strong reveal or a strip of glass could clarify this point of juncture.

Three more areas come to mind when considering the construction and use of folded plates: the treatment of the underside of the plates, the glazing, and the problem of utilization in a building of more than one story.

The treatment of the underside and glazing are both problems of detail, yet the details often make the building. Certainly it is confusing if the underside of the plate is not exposed in the interior space. A hung ceiling covering the structure would, of course, destroy the form within. Folded plates can have excellent acoustical characteristics, so this should seldom be a problem.



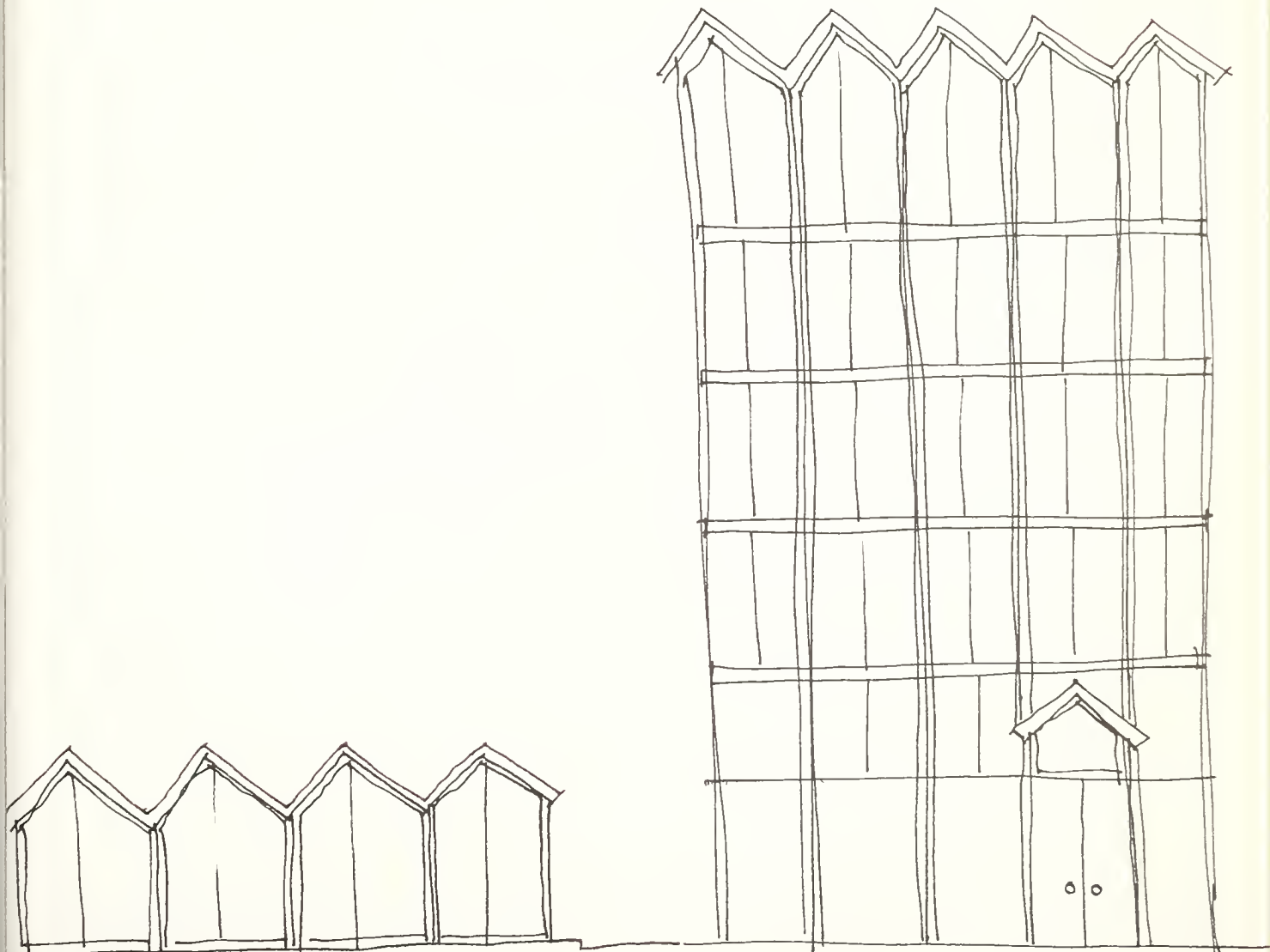
In many buildings the simplicity of the interior form is destroyed by the lighting system, whether it is plastered onto the form itself like little warts, or hung in a random fashion with little regard for the over-all effect. A well chosen lighting fixture can set off the roof to advantage, and the few dollars invested in the fixtures might be the difference between chaos and a noteworthy space.

It is interesting that in the application of so many of the well designed folded plate roofs the roofs are cantilevered well beyond the enclosing walls in front and rear. Visually this accomplishes two things: it lets the viewer know what is going on and prepares him for the space within. The roof overhangs cast shadows on the enclosing walls making them less of a visual barrier. If the enclosing walls are of glass, it is well that there is a cantilever because glass in the daytime reflects the sunlight and can appear more impenetrable than marble. A roof which seems to float at night when the lights are on inside causing the glass to disappear can seem an ominous block when the glass reads as a wall during the day. The classic example of this problem occurred with Nervi's Sports Palace at E.U.R. near Rome. The structural form, although not a folded plate, was a magnificent thing to behold while under construction. One day the structure seemed to disappear and an enormous green house was there in its place. The building had been glazed, and that was that. Only at night did it live again. The glazing had killed it by day. While there really is no answer to the problem of glazing, the roof cantilever system does help to maintain the visual integrity of a folded plate roof.

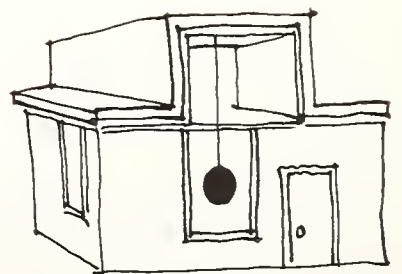
Another minor point in glazing which can't be stressed often enough is the size of the vertical mullions. Many a fine structure has been confused by having vertical mullions, which were meant to hold only plate glass, detailed as if they were major structural supports. And the viewer, with only his eye to guide him, has wondered indeed why the big powerful form above has been supported on such a multiplicity of columns.

Of all the aforementioned problems, none is more controversial than that of folded plates used on multi-story buildings. A folded plate is a long span structure. If the program calls for a series of floors of uninterrupted spaces, then theoretically it is possible to stack folded plate floors and infilling the folds on all but the roof. However, in the majority of multi-story buildings, the floors are on a standard framing system. Can this be aesthetically justified? The only case in which it might be justified is in a building in

which, by some strange quirk of program, all the large span spaces are on the top floor. Perhaps in a design expressing these long spans, perhaps the capping as well as a full height lobby might be justified. In other cases, the architect probably felt he needed a little snafu and worked in a bit of folded plate to make his elevations look jazzier. Misuse of a folded plate five stories above the ground is just as invalid as on a one-story overhead.



Who is really responsible when a good folded plate design is produced — the architect or the engineer? Both should take credit. The architect is not technically familiar with folded plates though he seeks to use them properly. The architect, in turning to the engineer, should look to him for direction not only in the calculation of a structure, but in its significance as well. There is enormous significance to such structures as folded plates; they are a basic part of the contemporary aesthetics, and the engineers who control them can render a real service by speaking up when the structural systems are misused. A fine building is a tribute to all who worked on it, and real teamwork between engineer and architect is too seldom achieved but an end greatly to be desired. When over-all design and structure come together in good work, it is always worth the extra thought invested in it. Folded plates are in themselves so handsome that every effort should be taken not to destroy their integrity, a job which requires the best both professionals have to offer.



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